DiMES and PFC relevant experiments from DIII-D

1. DiMES sample and hard wares
2. VDE disruption shot #114667

   Equilibrium and parameters
   Surface temperature distribution
   Particle flux distribution
   Tile currents
   Erosion of graphite DiMES

3. C^{13} co-deposition experiment
4. He discharges on physical and chemical sputtering

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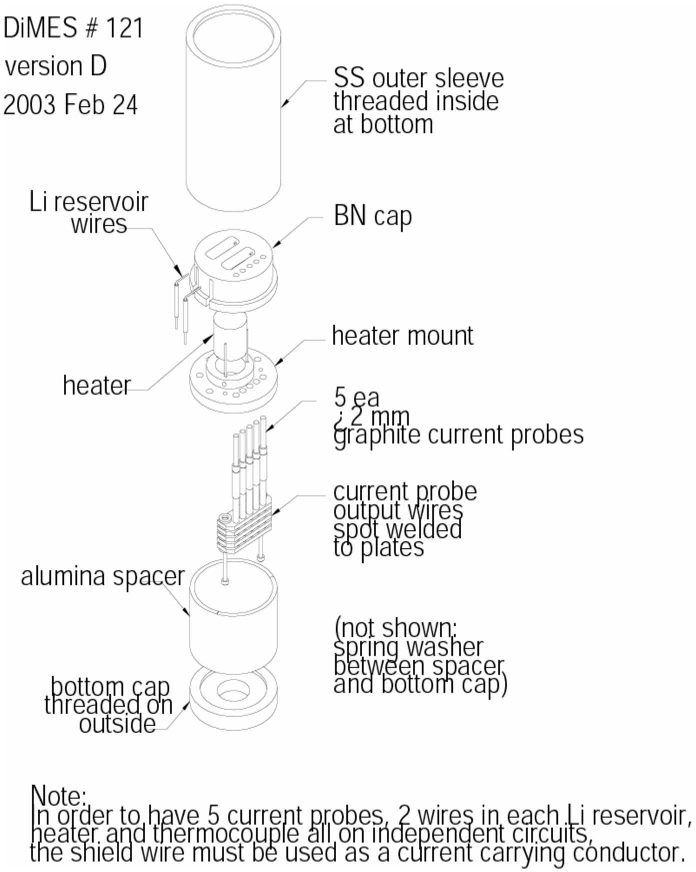
DIII-D NATIONAL FUSION FACILITY SAN DIEGO

US PFC Meeting, Nov. 17-20, 2003, Oakbrook, IL.

Li-DiMES and additional hard wares



Li-DiMES w/o Li-slots

DiMES rack with power supply

DiMES internal cables terminal

5 channels of optically coupled isolated amplifiers are in order.

Disruption in DIII-D to simulate ITER ELMs
DiMES exposure to shot # 114667

- **ITER FEAT ELMs[1]: 0.5-2 Hz, $\Delta W_{th}/W_{th}$~2-6%, implies 1.2 to 3.6 MJ, when W_{th}=60 MJ, deposition time 0.1-1 ms.**

- **DIII-D VDE disruption: Total energy release 0.5 to 2 MJ (thermal+magnetic+conduction+radiation+auxiliary) dissipated in a 2-3 ms.**

The goal is to provide disruption data from DIII-D and corresponding DiMES material surface erosion/damage to bench mark ITER ELMs modeling.

DIII-D
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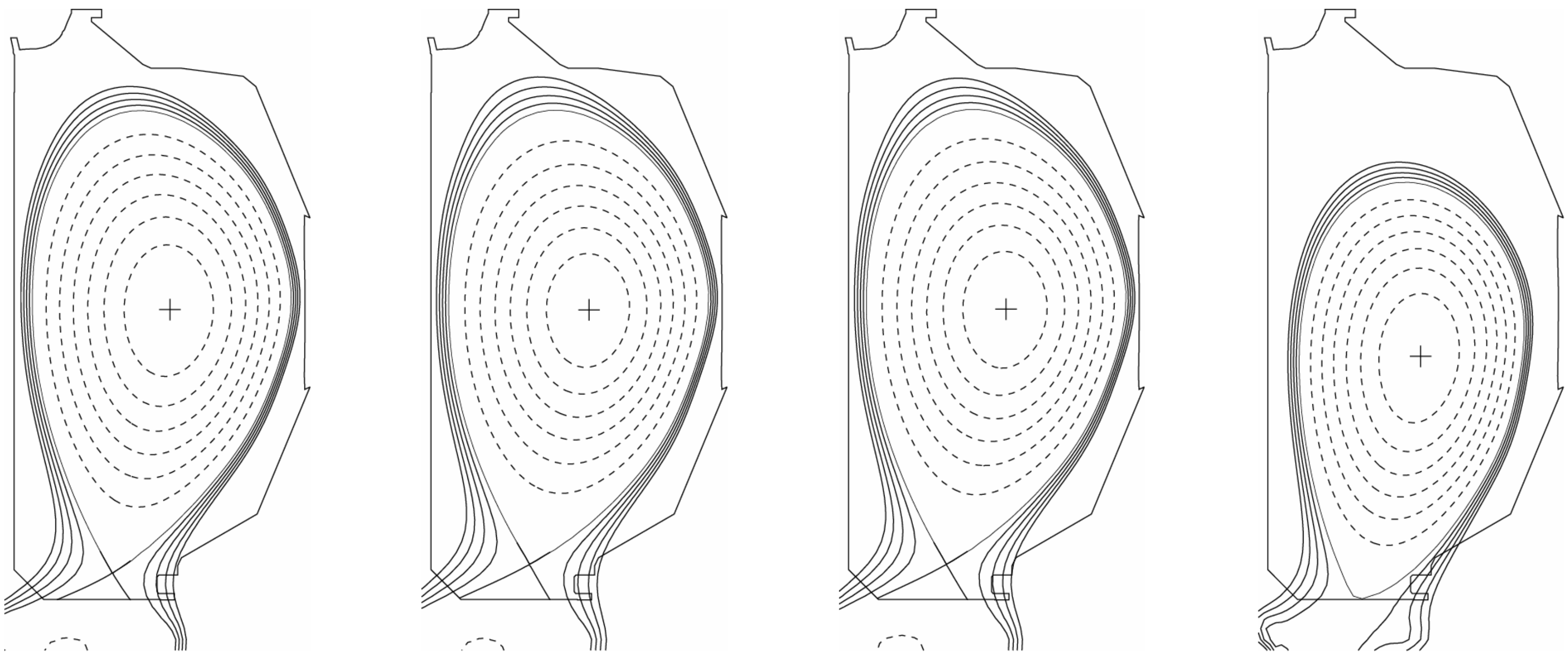
SAN DIEGO

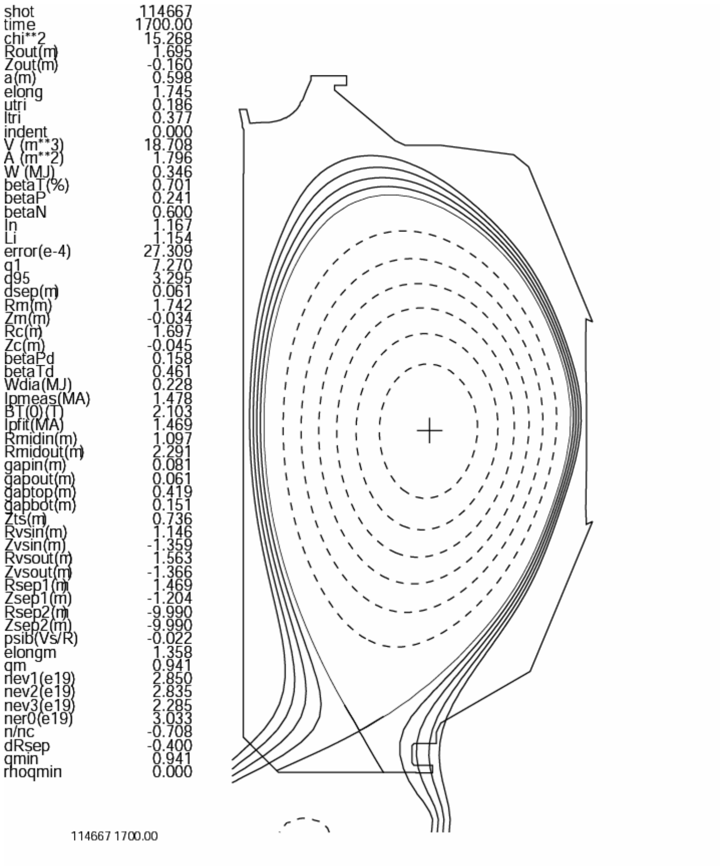
[1]G. Federici PFC review 2001

DIII-D VDE Displacement shot # 114667

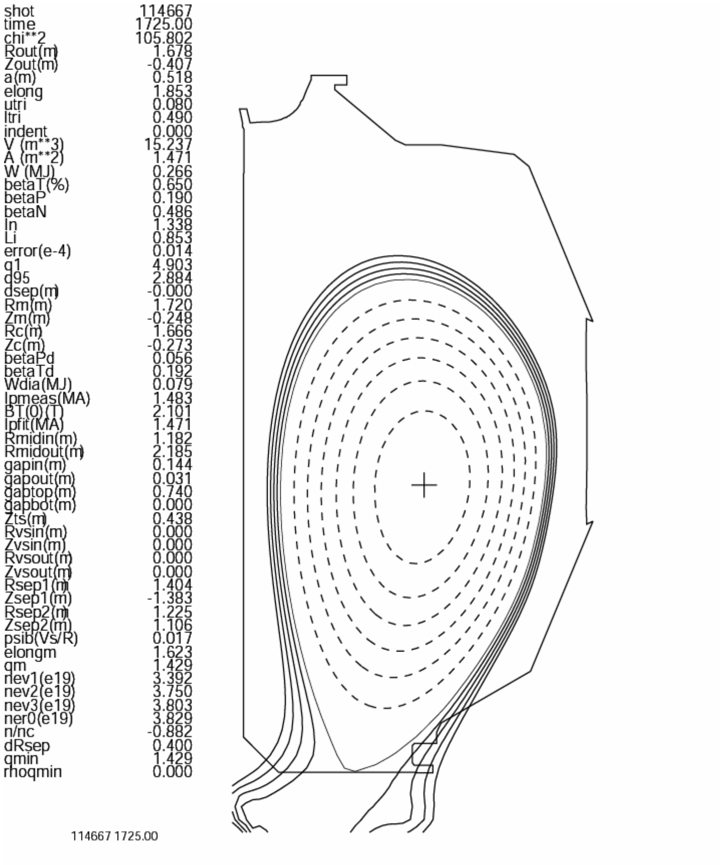


1000 ms 1500 ms 1700 ms 1725 ms

Equilibrium parameters

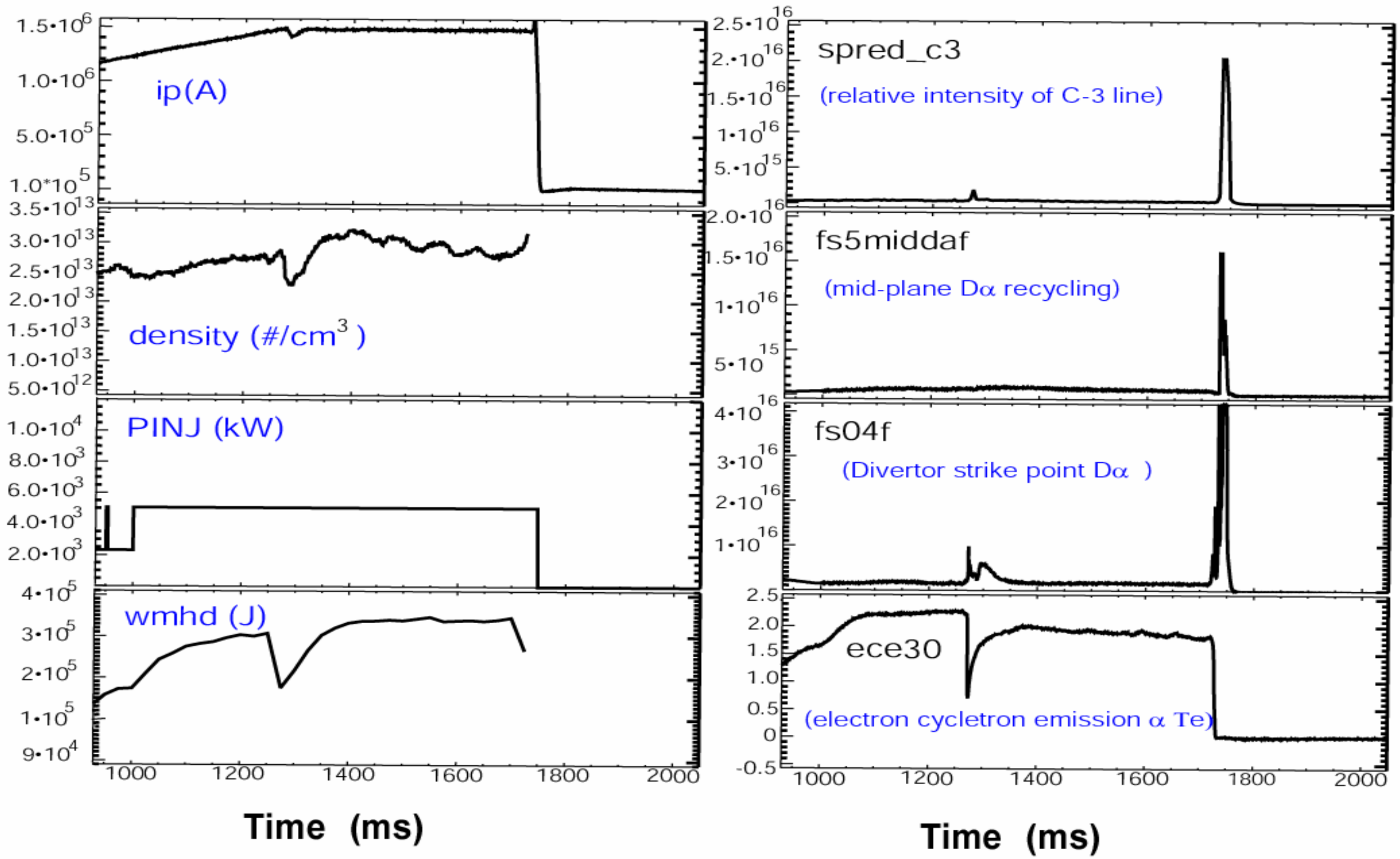


1700 ms

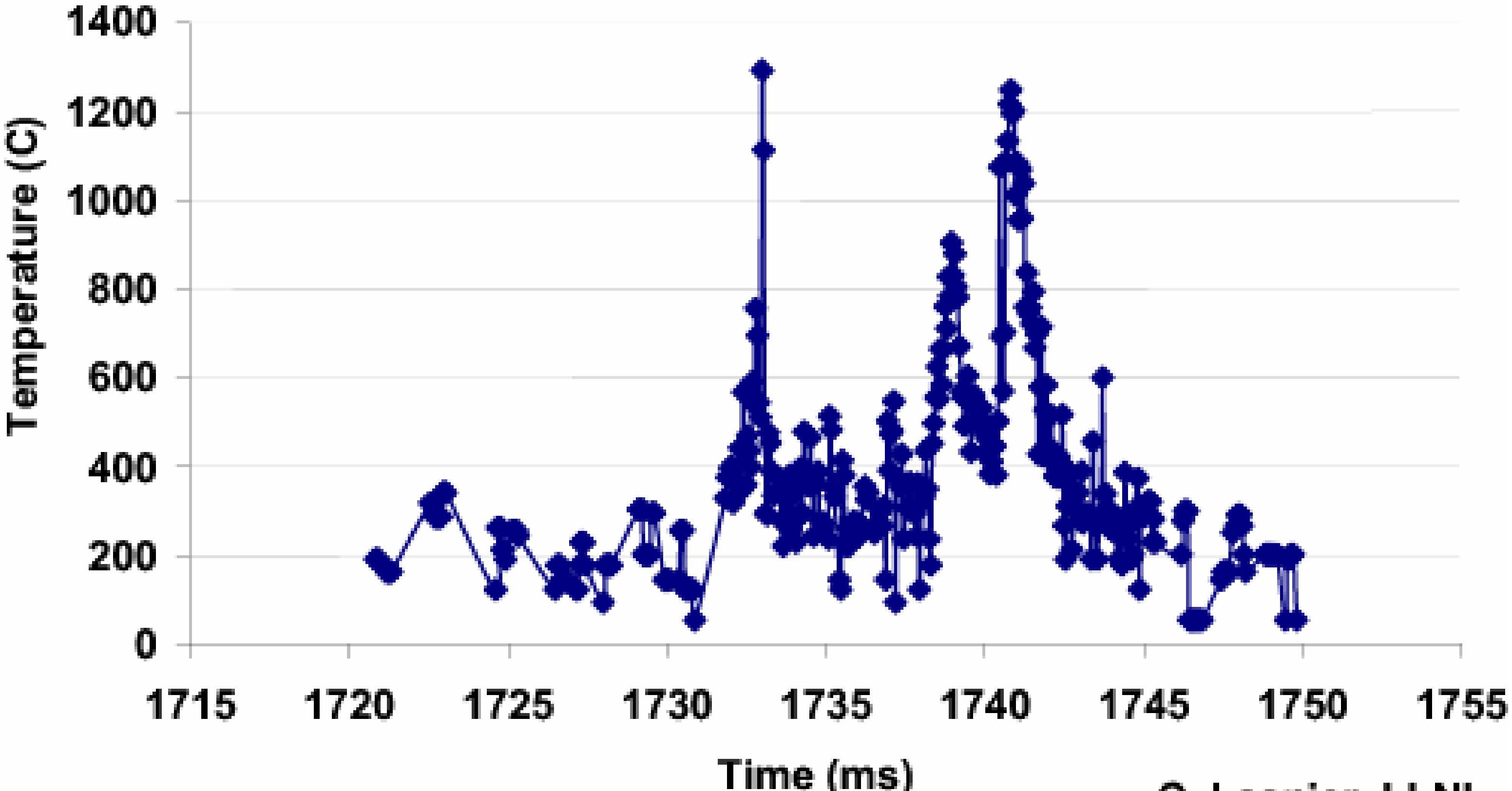


1725 ms

Selected plasma parameters (disruption shot 114667)

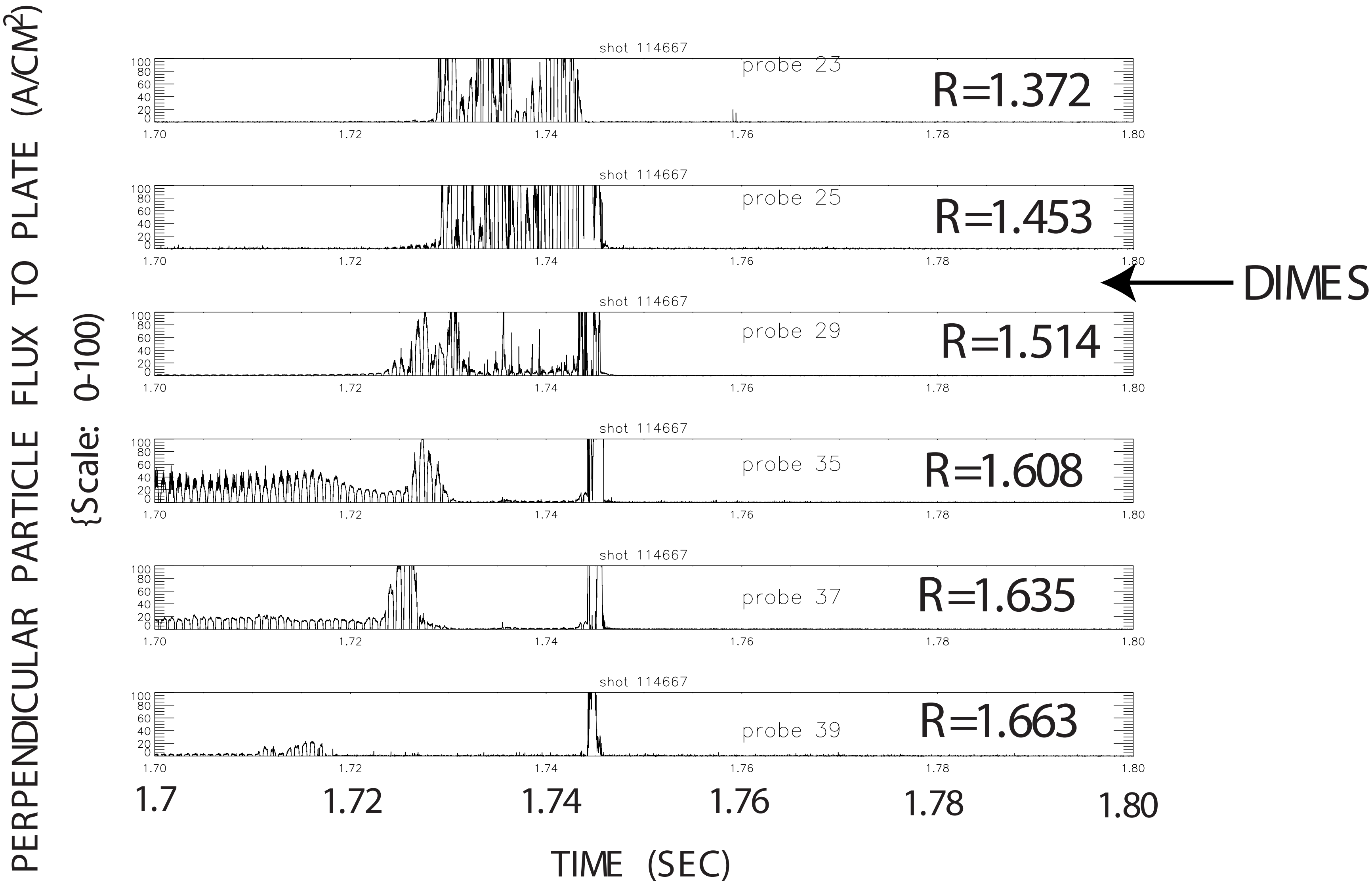


Surface temperature response to disruption (#114667)



C. Lasnier, LLNL

FAST TARGET PLATE MEASUREMENTS SHOW DISRUPTION CONDITIONS



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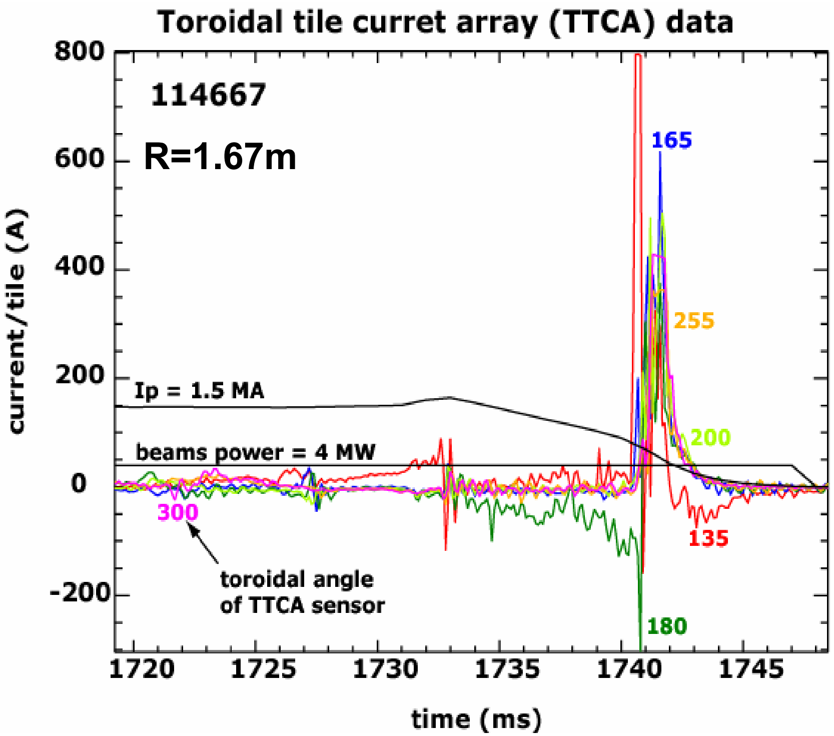
J. Watkins, SNL

Sandia National Laboratories

SOL current distribution in the toroidal tiles from DIII-D disruption # 114667 (array located 1 tile out from DiMES)

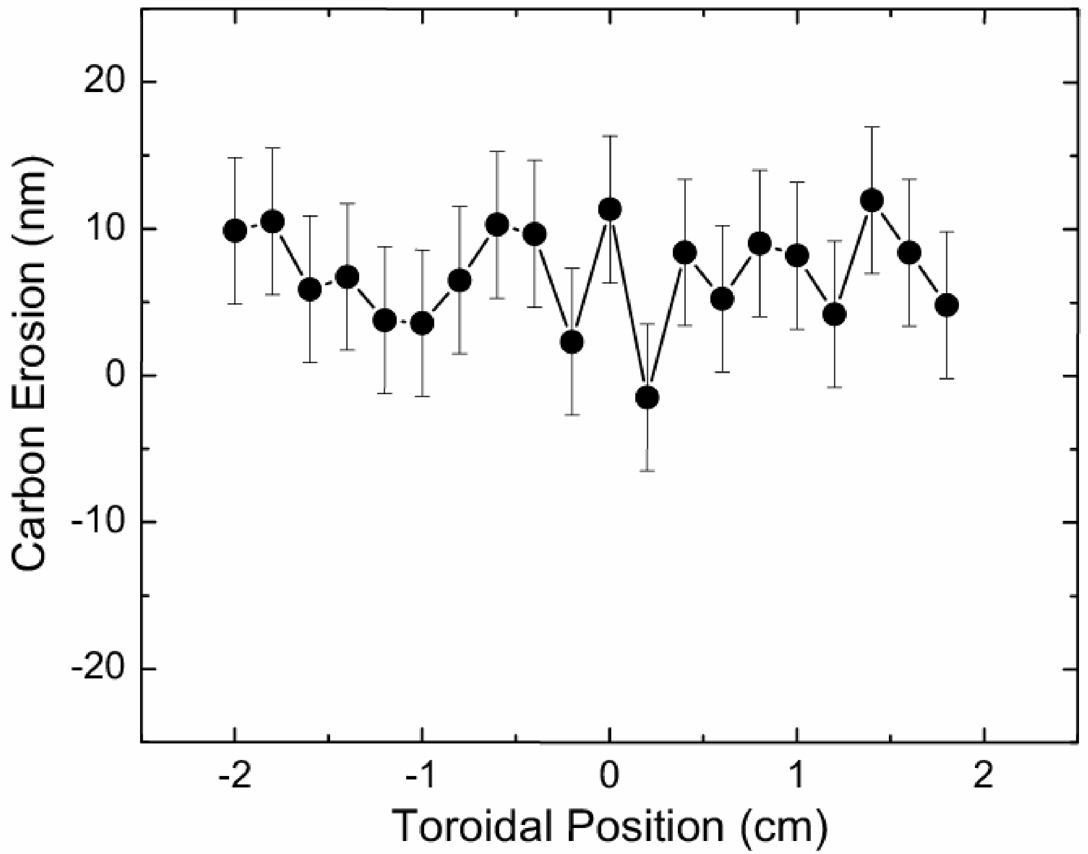


- The new high resolution DiMES tile current array will be used to study:
  - ELMs during stochastic boundary ELM control experiments
  - ITER ELMs simulations during DIII-D disruptions, and
  - The detailed structure of the SOL currents across the separatrix for MHD stability modeling.

- Large toroidal asymmetries are observed in the SOL currents during ELMs and disruptions in DIII-D.
- Similar currents can have strong impacts to the structural loading of ITER divertor components and the migration of evaporated or melted materials.
- These tile currents should be included in the ELMs and disruption modeling.

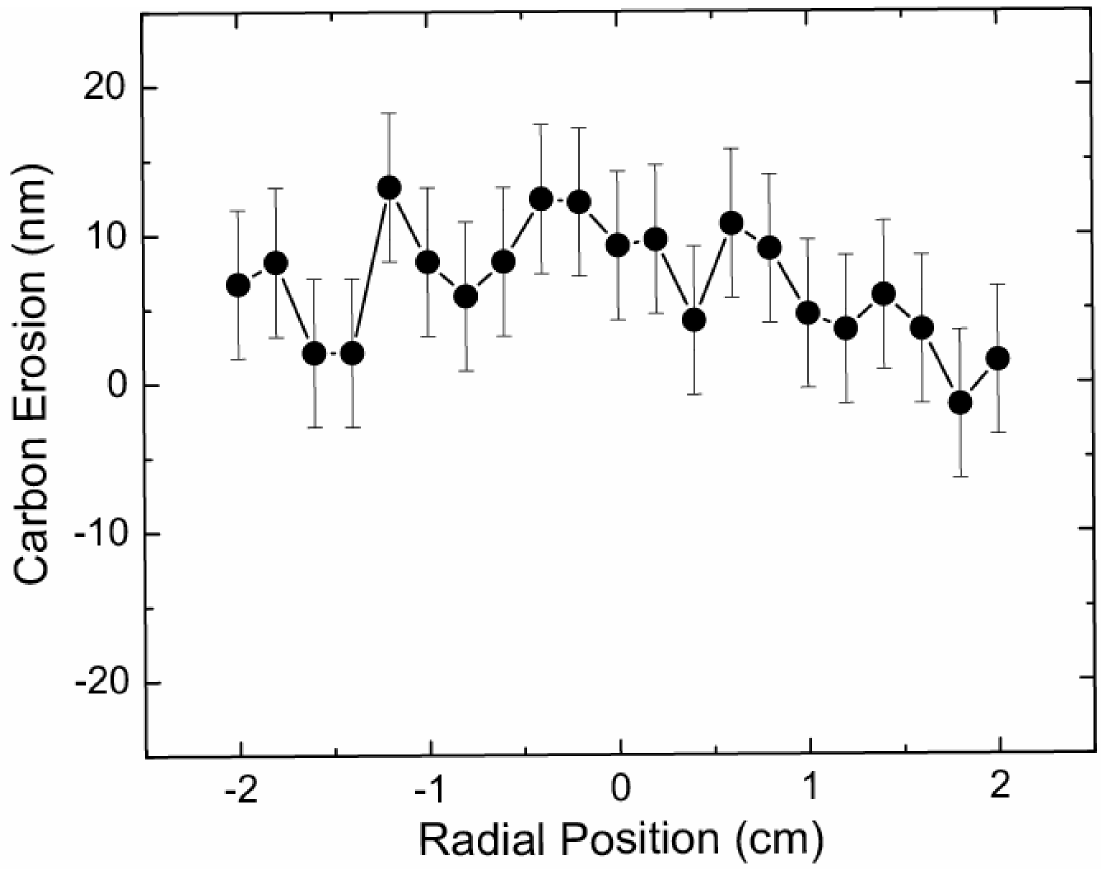
T. Evans

DiMES sample101 after exposure to VDE disruption 114667
(Toroidal position)



W. Wampler SNL

DiMES sample 101 after exposure to VDE disruption 114667
(Radial position)



W. Wampler SNL

ITER ELM simulation observations

- Fast diagnostics are needed to quantify ELMs and disruptions physics. Optical measurements are usually too slow to distinguish details.
- Temperature, particle flux, tile current variations and distributions have been recorded for shot # 114667
- Significant toroidal, radial and temporal variations are shown.
- Similar variations have been observed for both ELMs and disruptions.
- These variations should be included in the ELMs and disruptions modeling codes.
- Further analysis on available data on shot #114667 will continue.
- Consistent yet very low erosion of graphite surface has been measured on disruption shot #114667 with different toroidal and radial distributions.

- We should continue to perform well planned experiments to investigate different ways to perform experiments using DiMES and/or in DIII-D to provide experimental data to bench mark modeling efforts. (e.g. ELMing discharges on DiMES surface with low melting point metal like Li or Al, disruption discharge on a DiMES multiple materials sample…)

CoDep Tracer Experiment on DIII-D

Question: Where does chemically sputtered carbon from the main chamber wall redeposit?

Why are we interested: Chemical sputtering is an important source of carbon in the DIII-D main chamber

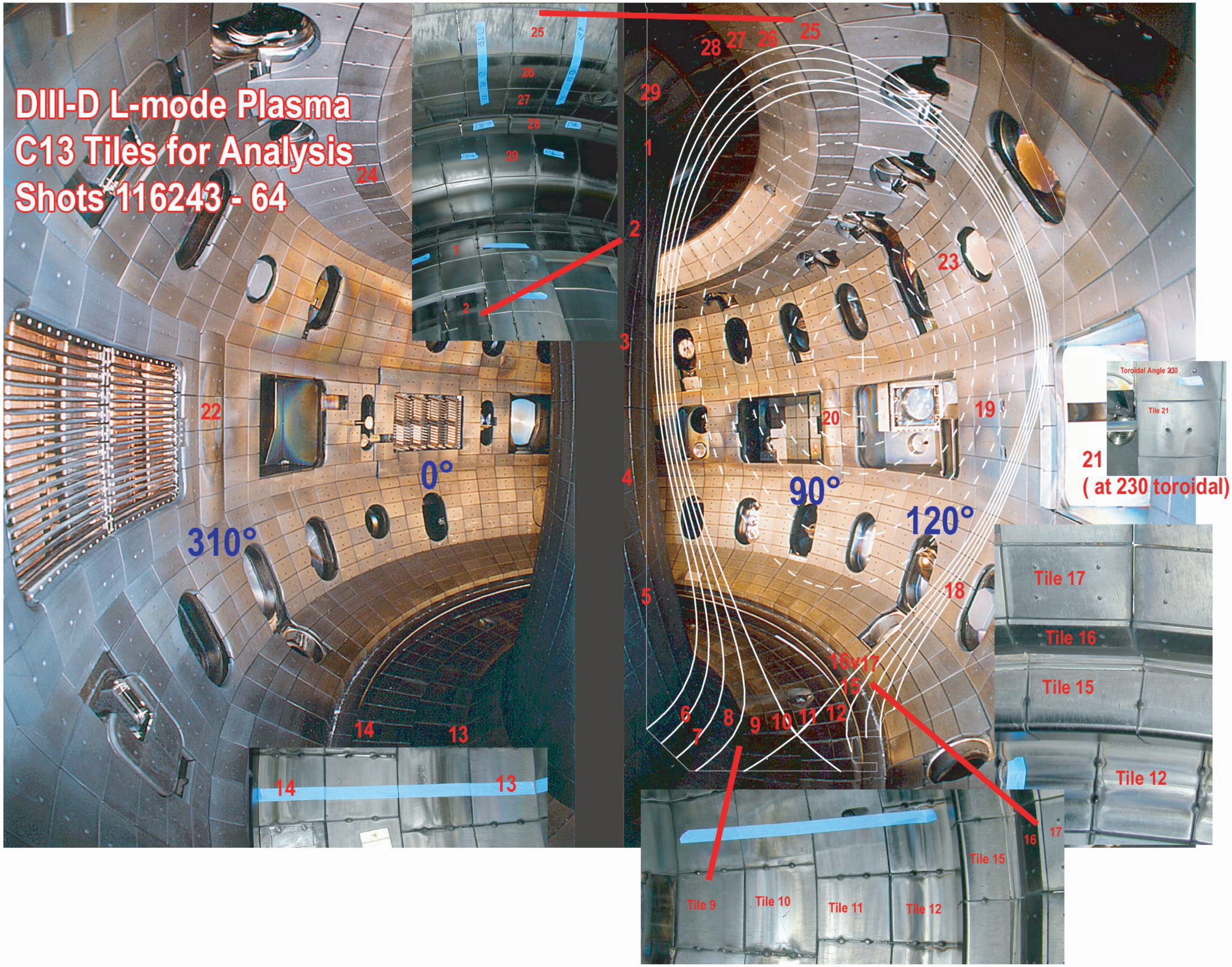
Redeposition of C leads to Codeposition of hydrogen isotopes. Location of codeposition of tritium is a key issue for ITER

Experiment to address this question:

- Inject $^{13}CH_4$ into main chamber on last day of operations before a major vent
- Remove a poloidally distributed set of tiles and analyse surface for ^{13}C content.
- Inject methane under upper baffle to provide a toroidally distributed source
- Use highly repeatable L-mode plasmas for 1) injection of sufficient ^{13}C for detection above the background and 2) use previous detailed diagnostic characterization so that fluid models can be applied to analysis.

Success: 20 identical (as best as we can tell) discharges with $^{13}CH_4$ injection.
29 tiles removed and delivered to SNL-NM for Ion Beam Analysis.

Location of the 29 Tiles Removed from DIII-D and Photos of Tiles In-situ



DISTINGUISHING PHYSICAL AND CHEMICAL SPUTTERING FROM ANALYSIS OF C I LINESHAPES

by
N.H. Brooks
in collaboration with
R.C. Isler

Presented at
DIII–D Science Meeting

September 6, 2002

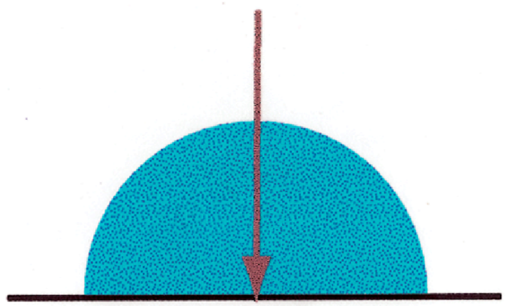
GENERAL ATOMICS

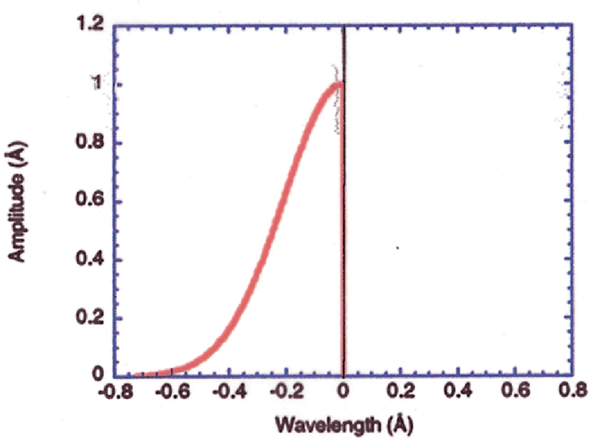
4.

Non-isotropic distributions

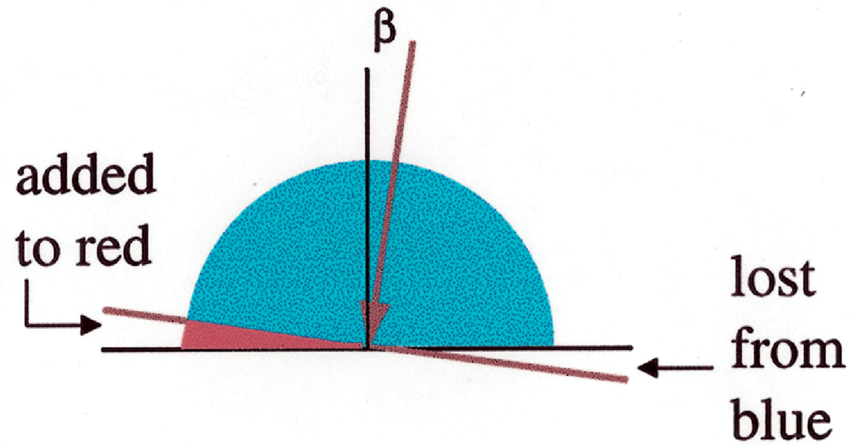
Maxwellian hemisphere

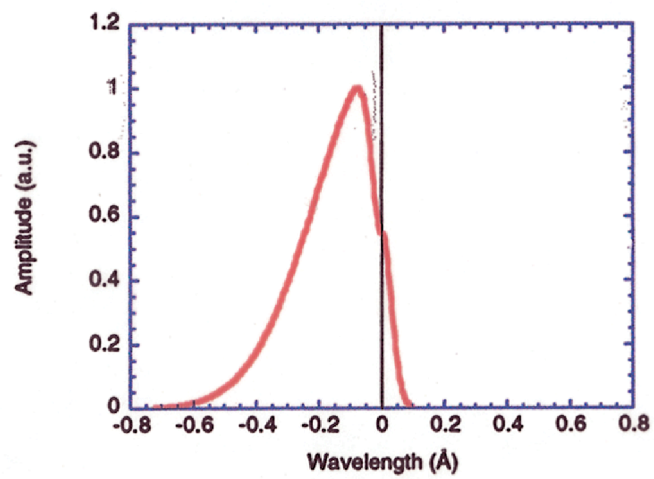
Normal View





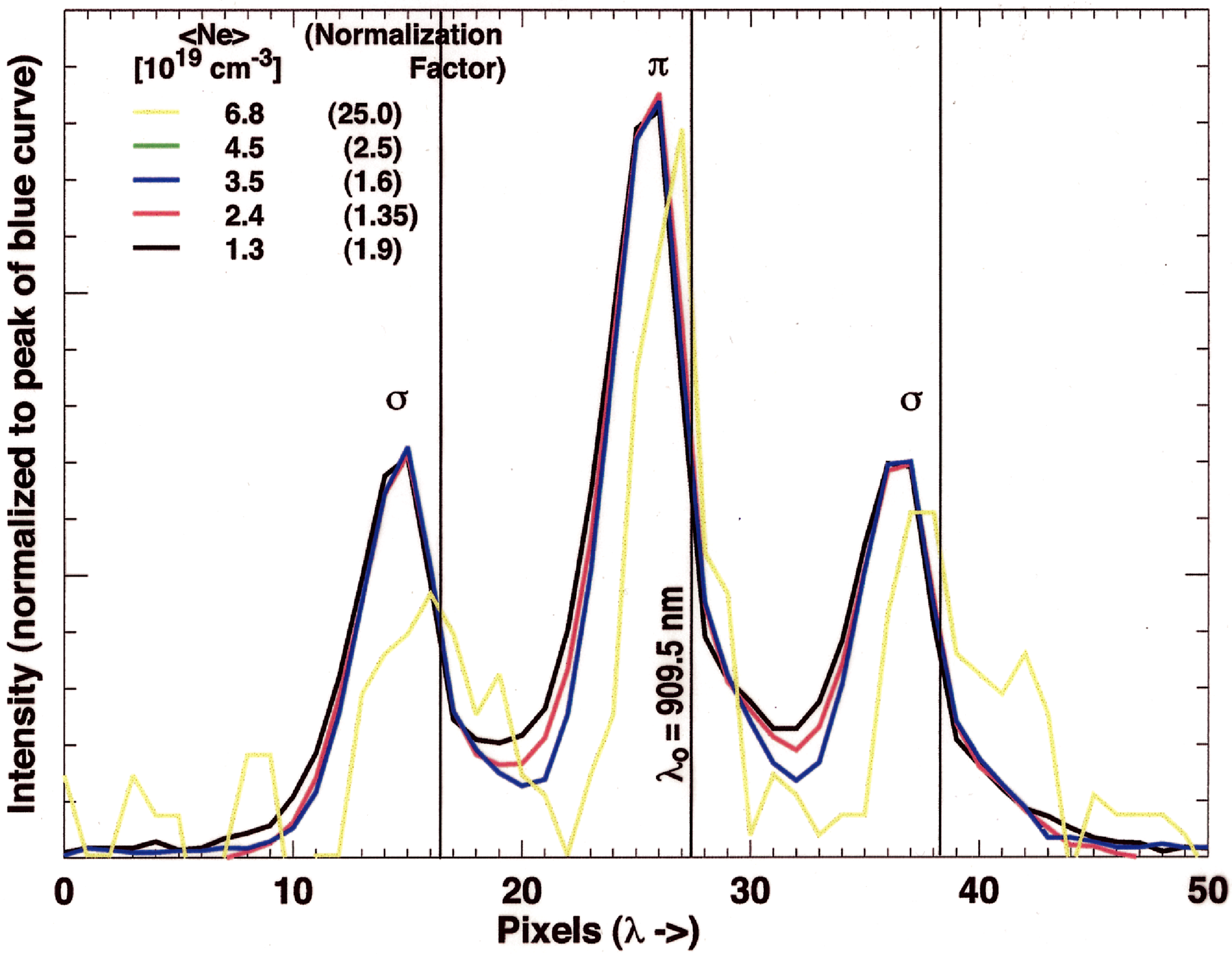
Angled View





PHYSICAL SPUTTERING OF GRAPHITE BY HELIUM

- Centers of the C I zeeman components shift to shorter wavelength as ion impact energy rises
- Line profile broadens asymmetrically on blue side



5.

Profile modeling for #105500, V6